Echo Meter User Manual

Model EM3

Wildlife Acoustics, Inc.

www.wildlifeacoustics.com

Firmware Version 1.0.0

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Electromagnetic Interference

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Use of ferrite clamped headphone and microphone cables are required to comply with the Class B limits in part 15 of the FCC rules. A Fair-Rite 0431173951 ferrite clamp (or equivalent) must be placed on the headphone and/or microphone cables with the ferrite residing within one loop of the cable. This ferrite clamp is included with Wildlife Acoustics microphone cables.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

Table Of Contents

Introduction **1**

Getting Started **3**
- Layout 3
  - Buttons and Ports 3
  - Display 4
- Powering Up 4
- Settings 4
  - Time: 5
  - Sample Rate: 5
  - Prefix: 6
  - Format: 6
  - Max dur: 6
  - Trigger: 7
  - Schedule: 8
  - Buttons: 8
  - Save and exit? 8
  - Erase all files? 8
  - Set factory defaults? 9
- Gain 9

Monitoring and Playback **11**
- Volume and Output source 11
- Starting and Stopping Monitoring 11
- Broadband Monitoring 11
- Heterodyne Monitoring 13
- Playback 14

Spectrogram Display **15**
- Viewing Modes and Adjustments 15
- Compressed and Expanded Views 16
- Viewing Past Calls 17
- Frequency Reference Line 18
- Zooming in the X and Y Axes 18

Recording **21**
Active Recording 21
Recording Modes 21
Stopping and Restarting 21
Trigger Display 22
Time Stamps 22
Tags and Voice Notes 22
Scheduled Recording 23

Batteries and Charging **25**
Charging 25
Monitoring Battery Life 25
Other Power Options 25

Flash Cards **27**

Managing the Recordings **29**
Transferring the Recordings to a Computer 29
Using Song Scope 29
Using WAC2WAV 29

Optional GPS Antenna **31**
Using the GPS Antenna 31
Viewing the GPS Data 31

Specifications **33**

Warranty **35**

Declaration of Conformity (EN 45014) **39**

Introduction

The Echo Meter EM3 Handheld Ultrasonic Recorder was designed from the ground up specifically for active ultrasonic handheld monitoring. It includes several technologies for monitoring bats in real-time and to simultaneously record bats using both full spectrum and zero crossing technology. Additionally, using state of the art digital signal processing techniques, the Echo Meter incorporates the first ever real-time spectrogram in a handheld unit.

The recorder is designed for outdoor use and can handle extreme hot or cold temperatures as well as high humidity. It is not, however, designed for use in precipitation.

The EM3 is shipped ready to use. It includes rechargeable batteries, an AC charger, and a flash card. The default factory settings allow you to begin monitoring bats in minutes.

The optional GPS accessory automatically logs your position for walking or driving transect surveys and accurately sets the EM3's internal clock to the correct time.

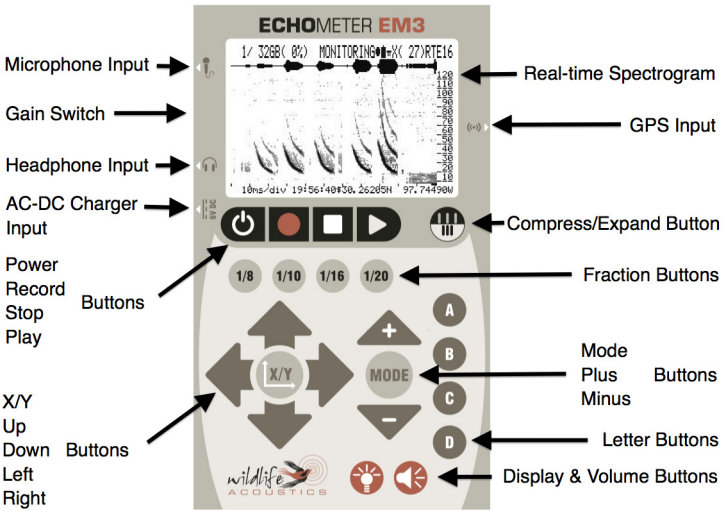
The EM3 can be used as a short-term passive recorder using a simple scheduling option. For complex schedules or long-term passive recording in any environment, the Wildlife Acoustics Song Meter SM2BAT is a more appropriate detector.

Getting Started

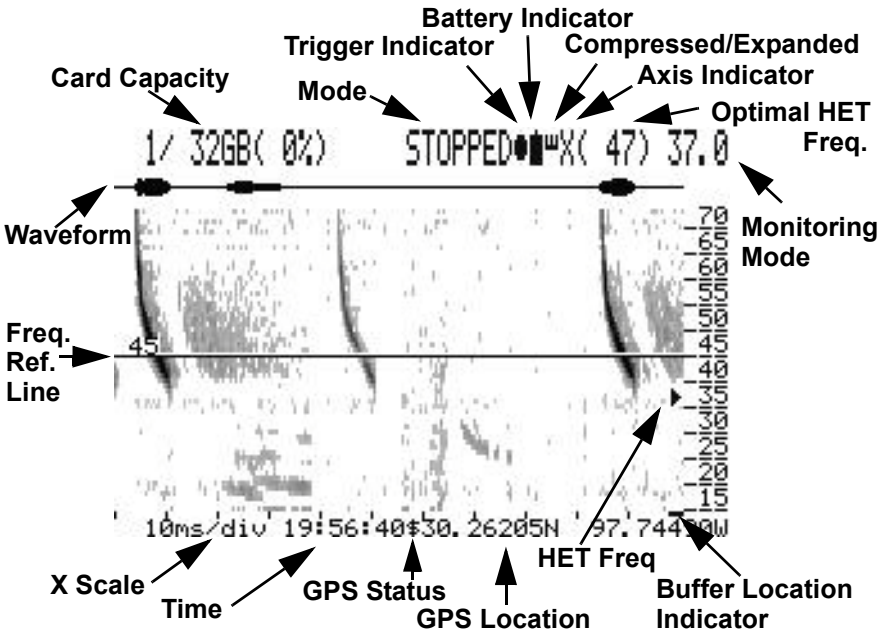
Layout

The layout of the EM3 inputs and buttons can be seen below. The subsequent sections of this User Manual will discuss the functionality behind the buttons in detail.

Buttons and Ports



Display



Powering Up

To power on the unit, press the Power button until you see the Wildlife Acoustics splash screen. After a few seconds you will see the spectrogram. The first time you power up the unit, it will be in monitoring mode. When the unit is powered down it will remember its last mode for the next power up. To turn off the EM3, just press and hold tshe power button until you see "Shutting Down" on the top of the display. The spectrogram history buffer and the settings are preserved and present when you turn the unit back on.

Settings

Press and hold the X/Y button to enter the settings menu.

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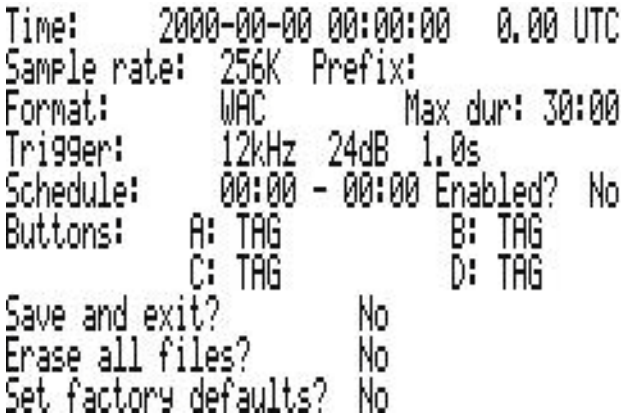
The default settings are shown below.


Time: 2000-00-00 00:00:00 0.00 UTC
Sample rate: 256K Prefix:
Format: WAC Max dur: 30:00
Trigger: 12kHz 24dB 1.0s
Schedule: 00:00 - 00:00 Enabled? No
Buttons: A: TAG B: TAG
C: TAG D: TAG
Save and exit? No
Erase all files? No
Set factory defaults? No

Use the Left and Right Arrow buttons to navigate to a setting field and the Up and Down Arrow buttons to change the setting. When positioned at a left most settings field, the Up and Down Arrow buttons will go to the previous and next settings row.

Time:

Set the time and date as well as the UTC (Universal Time Coordinated) time zone offset. The UTC setting is necessary to assure the correct time display when using the GPS. If the batteries are removed from the EM3 for longer then about 30 seconds, the clock will cease to keep time. If the clock has been reset due to extended removal of batteries or batteries that have been fully discharged, the clock setting will blink ??:??:?? on the spectrogram display so you know it is incorrect and needs to be set.

Sample Rate:

Set 256kHz or 384kHz sample rate. Each can record up to a maximum of half the selected sample rate (i.e. 128kHz and 192kHz respectively). The 384kHz setting will consume card space faster and the calls displayed on the spectrogram will be less smooth. At the higher 384kHz sample rate, the spectrogram display is not "overlapped" as with the 256kHz sample rate so the calls shown will appear more pixilated.

Prefix:

Here you can specify a filename prefix of up to 12 characters that will be prepended to the recordings filename. This can be used to uniquely label recordings made by each Echo Meter (e.g. to designate a location and/or project). Use the Up and Down button to scroll through the letters, numbers and hyphen. Use the Right button to advance to the next character space.

Format:

There are three recording formats that can be selected; WAC, WAV or WAV/ZC. In WAC mode, recordings are made in Wildlife Acoustics' proprietary lossless WAC compression format (WAC0 for those familiar with Wildlife Acoustic's Song Meter passive recorders). WAC files are intended to be set for long durations, several minutes to 30 minutes. In WAV mode, a discrete WAV file is created for each trigger. In WAV/ZC mode, an Anabat sequence file is additionally created. For ZC output, the division ratio used is either 8 in RTE or HET monitoring mode (details on those later), or twice the division ratio selected when using FD monitoring mode.

The best recording format is dependent on your particular needs. WAC does have a few advantages over WAV/ZC. In WAC, files will be about 60% the size of WAV files. Additionally, in WAC mode, the unit records continuously until the max duration is reached. There is no pause time between triggers, it is always ready to record. Another advantage is that you can monitor uninterrupted in WAC mode whereas in WAV mode, RTE output and the spectrogram will pause during the save and prepare file process, this process takes under a second after each triggered recording. The only disadvantage of WAC files is that they must be converted to WAV or ZC files using Wildlife Acoustics free WAC2WAV software (found in the “Downloads” section of Wildlife Acoustics’ website). before they can be analyzed in most popular analysis software. The WAC files can, however be opened in Wildlife Acoustic’s Song Scope software.

Max dur:

Maximum duration sets the maximum recording time in any recording mode. This can be set from 1 second to 30 minutes. In WAV or WAV/ZC mode, this will set the maximum trigger length. This can be used

to specify a max recording size to assure compatibility with your analysis software. In WAC mode this is used to set the maximum WAC recording time. It will not affect trigger length. Max trigger length for WAC files can be adjusted in post processing using the WAC2WAV software.

It is important to note that when the batteries die during a recording, that recording cannot be written to the card and is lost. For this reason, you may want to set the max duration setting lower in WAC so as to prevent data loss. There will be a couple seconds in between each WAC file where data will not be recorded.

Trigger:

These are the recording trigger settings that determine what the EM3 considers a triggered event for recording. The triggers allow significant reductions in file size by only recording when there is bat activity. Note that these settings have no effect on what will be displayed on the spectrogram or presented in the speaker/headphone audio.

The EM3 monitors the spectral noise across the frequency spectrum. When a signal is detected that is both above the specified trigger frequency (in kHz) and is at least the specified level threshold (in dB) above the ambient background levels, a trigger is detected and the unit will begin recording. The recording will continue until no trigger is detected for the specified trigger window period of time or until the maximum duration (see above) has been reached.

To enable a recording trigger, first, set the frequency threshold in kHz. This is the setting directly to the right of "Trigger:" This should be set lower than the frequency of any echolocation of interest. Note that lower values may result in false triggers from low frequency noise sources. Next set the amplitude threshold for the trigger. This is directly to the right of the frequency threshold. Higher values are less sensitive and lower values are more sensitive. 18dB is recommended as a good starting point. Next, set the trigger window in seconds. This is directly to the right of the amplitude threshold. A triggered event will continue as long as there is activity that exceeds these amplitude and frequency thresholds and then will continue for the specified trigger window after the last trigger. In other words the recording will continue as long as there is activity, and then will continue for the trigger

window after activity has no longer been detected or until the maximum duration is reached, whichever comes first.

When the EM3 is triggered and recording, a circle appears to the right of "RECORD" on the display. The circle also appears when monitoring so you can get a sense of trigger function and adjust settings accordingly.

Schedule:

Set the start and stop time for scheduled recordings. You also must enable the feature here. Details on scheduled recording are in the Scheduled Recording section on page 20.

Buttons:

This sets the functionality of the Letter buttons. These buttons can function as heterodyne frequency presets or can 'tag' a recorded file name with the button letter pressed during the recording.

The Letter buttons will act as tags unless a heterodyne preset has been set in the settings menu. Details on tag functionality can be found on page 19. If a Heterodyne preset is set, that Letter button will immediately tune to that frequency when in Heterodyne monitoring mode (but will not tag). When in Real Time Expansion or Frequency Division mode, and a Letter button configured as a heterodyne preset is pressed, the EM3 will switch to Heterodyne mode and tune to the preset frequency.

Save and exit?

To save all settings, select Yes and then press the X/Y button to exit the settings menu. You may exit without saving the modified the settings by pressing and holding the X/Y button.

Erase all files?

This will erase all files on the flash card. If you select Yes and then press the X/Y or Mode button, all files will be erased and the EM3 will exit the settings menu.

Set factory defaults?

This will return all defaults to factory presets. If you select Yes and then press the X/Y button, all settings will be returned to factory defaults and the EM3 will reboot. Factory default settings include the settings found in the settings menu as well as contrast, brightness, display view mode, zoom levels, volume and several other parameters such that the EM3 will be in the same state as new. Alternatively, holding the Left button while removing and reinstalling a battery will restore all factory defaults as well.

Gain

Gain is set with a three-way switch on the left side of the EM3. Available gains are 36dB, 30dB and 24dB. The settings positions are not in that order. Positions are shown on the label on the bottom of the unit.

The EM3 ships with 36dB set as a default and this is optimal for most cases. If a loud bat echolocates very close to the microphone, clipping may occur and the gain should be set lower for better recording quality.

SM2BAT users note that these gain settings do not equate to the same settings on an SM2BAT as the EM3 microphone has a different circuit and is more sensitive than an SMX-US.

Monitoring and Playback

The EM3 can convert ultrasonic bat echolocations to audible frequencies in real time using three technologies: heterodyne (HET), frequency division (FD) or Wildlife Acoustics' Real Time Expansion (RTE). Regardless of which monitoring technology is selected, the unit can simultaneously record in full spectrum and optionally zero crossing to the flash card. Calls can also be made audible using time expansion playback.

Volume and Output source

Sounds can be monitored through the speaker on the back of the unit or through headphones via the standard stereo headphone connector on the left side of the unit. Inserting headphones will mute the speaker. To adjust volume for either, press the Speaker button and then press either the Plus/ Minus buttons or the Up/Down buttons to adjust the volume. Pressing any other button or waiting 5 seconds exits the volume adjustment mode. The adjustment level is displayed on the bottom of the screen.

Starting and Stopping Monitoring

To enter monitoring mode from stopped mode, press the Mode button. You will see MONITOR on the top line of the display. This indicates that the unit is monitoring but not recording. During a recording you will see RECORDING on the top line of the display indicating that the unit is both recording and monitoring.

To stop monitoring or recording press the Stop button. In recording mode, the Stop button will also stop the monitoring. Recording is covered in a subsequent chapter. In stopped mode the spectrogram does not update and you will see STOPPED on the top line. To restart monitoring, press the Mode button.

The unit will power down if no button is pressed in Stopped mode for a few minutes to conserve batteries.

Broadband Monitoring

The Mode button toggles between broadband monitoring and HET monitoring. Broadband monitoring allows you to hear bats at all frequencies, whereas HET monitoring only plays bats around a tuned frequency.

There are two broadband monitoring technologies. Press and hold down the Mode button to switch between Real Time Expansion (RTE) and frequency division (FD). At the top right of the screen you will see RTE or FD with the selected division ratio (see below).

The default broadband monitoring mode is RTE. RTE is a patent pending method of acoustically delivering the maximum amount of spectral and temporal information of the bat echolocation in real-time. It is the closest thing to having bat ears! The ultrasonic signal is expanded in sub-millisecond scales, such that the echolocation is actually expanded into the silences between the echolocation calls.

Alternatively, you can select Frequency Division (FD) as the broadband monitoring mode. FD, also known as zero crossing, is a method of converting calls to the audible range by detecting the zero crossing of the ultrasonic signal to produce a square wave, dividing the square wave by the division ratio and then playing back the divided square wave through a filter. Before the advent of more sophisticated microprocessors, FD was the only method for monitoring broad-spectrum. This technology does not provide as much tonality as RTE, but is provided for those accustomed to this method. FD requires that a threshold be set such that only higher amplitude waveforms result in a "zero crossing". If the crossing was truly zero, the output would be only white noise and no bats would be heard. To set the frequency division sensitivity threshold, press and hold the speaker button to go to FDADJ (FD adjustment) mode. Now the Plus and Minus buttons can be used to adjust the threshold while you listen to frequency division output. You want to set the threshold a couple levels above the point that constant white noise is heard. RTE does not require any adjustment and this threshold has no effect on the mode.

In broadband mode (RTE or FD) the Fraction buttons can be used to select the division ratio that will be applied to the bat echolocations.

The audible output of the bat echolocation will be a fraction of the original frequency dependent on this selection. For example a 32kHz echolocation would be heard at 2kHz if the 1/16 division was selected. The division ratio is shown to the right of the monitoring mode (RTE or FD) on the display.

Once you have selected the preferred broadband monitoring mode (RTE or FD), momentarily pressing the Mode button again (but not holding down)

toggles the EM3 between the selected broadband monitoring mode and HET. The intended use is that you would monitor in broadband (while viewing the spectrogram) and then, if your ears prefer, "zoom in" acoustically on the echolocations with HET.

Heterodyne Monitoring

Heterodyne (HET) is a narrow-band method that lets you tune to a narrow range of ultrasonic frequencies (about 8kHz range on the EM3). HET uses a tunable carrier wave to play the difference in frequency between the carrier wave and the echolocation call. This allows the frequency to be shifted to an audible frequency range. Using this technology, small differences in the frequency of the echolocation can sound quite dramatic in the audible output signal. For example, if the HET is tuned to 50kHz and a bat echolocates at 51kHz, the EM3 will play back at the difference of 1kHz. If another bat echolocates at 55kHz it will be heard as 5kHz. Even though the frequencies of the original call are only 10% different the sound played for the user is 500% different. Because of this effect, HET can be a useful tool to differentiate species with similar calls at similar but different frequencies. Also small variations in the call frequency are sometime indicative of species and are exaggerated by this effect.

HET mode has three methods of tuning the frequency: auto, preset and manual. When you press Mode to enter HET mode, the EM3 automatically calculates the optimal HET frequency for that bat pass and tunes the HET frequency to that value. To retune to a new frequency of a new bat pass, double click the Mode button (this is really switching the EM3 into broadband mode and then back again to HET). This estimated optimal frequency is displayed in parentheses in the top right of the display and is shown in all monitoring modes. The tuned HET frequency is shown to the right of that with a .1 Hz resolution and is only shown in HET mode. There is also a triangular indicator on the Y axis indicating the tuned frequency.

A You can also go to HET mode by pressing one of the Letter buttons if you have configured the button as a HET preset in the Settings menu. If in HET mode, pressing a Letter button will simply tune the EM3 to that frequency. If in broadband mode (RTE or FD), pressing a Letter button will switch to HET mode at that frequency in one step.

B

C Additionally, the detector can be fine-tuned manually using the Plus and Minus buttons.

D In HET mode, the Fraction buttons have no effect.

Playback

You can also playback the bat echolocations using time expansion. First press the Stop button to stop recording and monitoring, then scroll back in time in the spectrogram using the Left Arrow button to the area you would like to play and press the Play button. You will see PLAYBACK on the top line of the display and the visible portion of the spectrogram will be played back, slowed down by the selected division ration on the Fraction buttons. You can also use the Up and Down Arrow buttons to zoom out the X scale (in X mode) to include a larger portion of the buffer in the playback. It is better to be in compressed mode for playback, as the space in between the echolocations will be quite long otherwise!

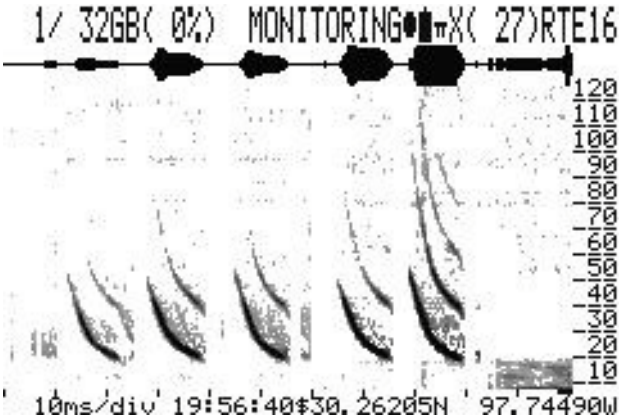
To continue monitoring, press the Mode button, or press the Record button to begin recording.

Spectrogram Display

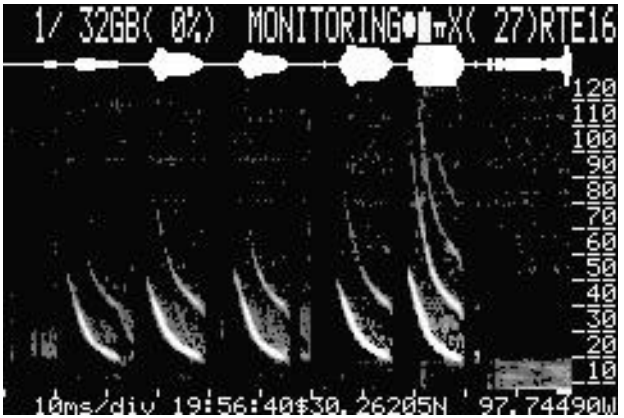
The EM3 has an integrated real-time spectrogram. This allows you to see important characteristics of bat echolocation as they are happening. While monitoring or recording, the spectrogram is updated with new bat calls.

Viewing Modes and Adjustments

The default view mode for the spectrogram is "black on white" as shown below.



If you press and hold the Display button the display will switch to "white on black mode" as shown below. This mode might be preferred for use in the field as it is easier on the eyes in the dark.



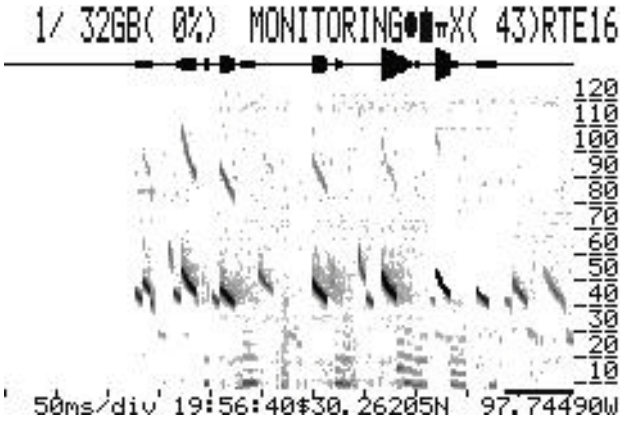
If you momentarily press and release the Display button, you can then adjust brightness using either the Plus and Minus buttons or Up and Down buttons. The contrast is adjusted using the Right and Left Arrow buttons. The adjustment levels are displayed on the bottom of the screen. Pressing any other button or waiting 5 seconds exits the display adjustment mode.

The backlight can be easily turned off by double clicking the Display button. This is useful if you are monitoring without watching the screen and want to conserve power or do not want the display interfering with night vision. From this state, any button will restore the backlight.

Compressed and Expanded Views

Two viewing options are available, compressed view and expanded view. You can toggle between these options using the Compress/Expand button. The icon symbol to the right of the battery capacity symbol on the top line of the LCD display shows which view you are in. Compressed view is shown as two straight lines and expanded view as three straight lines.

The compressed view removes the silent intervals between bat calls in the spectrogram so you can see more calls on the display. Expanded view shows the calls in "real-time". This is useful to understand inter-echolocation timing. In expanded view the window might display just the empty space between bat calls, so in this view it is better to zoom out. Zooming is described below. The same bat pass is shown in the two screenshots below. The first screenshot shows compressed view and the second expanded view.



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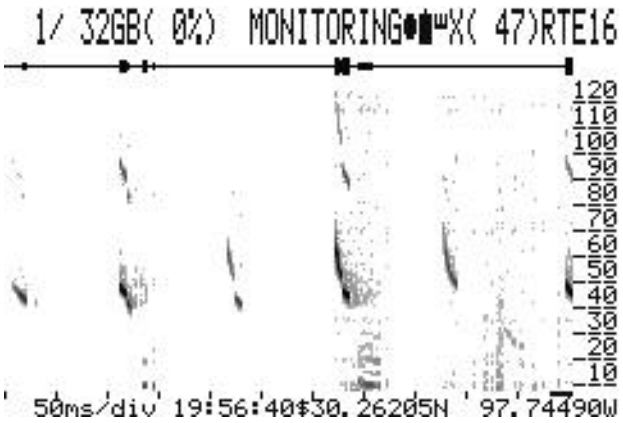


Viewing Past Calls

While continuing to acquire new bat calls, you can scroll back in time to review recent bat activity by pressing the Left Arrow button. Pressing and holding the Right or Left Arrow buttons will allow you to scroll more quickly through the spectrogram. The system can store about 5 seconds of continuous bat signals, but by compressing the silent intervals between bat calls, the actual time can be up to a few minutes depending on bat activity. The buffer is saved when the EM3 is powered off, so when it is turned back on, past calls are preserved. Note that when scrolled back to the back of the buffer to view past calls and still monitoring, the end of the buffer is moving with the new data being monitored, as it is finite in length. When what you are viewing at the end of the buffer is overwritten, the display will start to scroll forward in time with the new data. This can give the impression that you are viewing real time data, when in fact you are viewing old data that is scrolling! After reviewing past calls you can jump to the front of the buffer to display real time data by double clicking the X/Y button.

A scrollbar indicator shown as a black horizontal line on the X axis of the spectrogram indicates where you are in time as you scroll back through the spectrogram buffer. The width of the bar shows how much of the buffer you are viewing and the location shows the relative location in the buffer. If zoomed all the way out such that you were viewing the entire buffer on the spectrogram, the black bar would cover the entire width of the X axis. In expanded mode, the behavior might seem odd, as the relative width changes as you scroll back. This is because the silent spaces between echolocations

are stored efficiently; thus the amount of the buffer shown on the display is dependent on the percentage of silent space on the display.

Frequency Reference Line

A frequency reference line is available to aid in determining the exact frequency of a bat echolocation. The Plus and Minus buttons move the reference line in RTE/FD mode. In HET mode, however, the Plus and Minus buttons control the tuning frequency.

To hide the reference line, adjust it down and off the screen using the Minus button. Press the Plus button to scroll it back to visibility

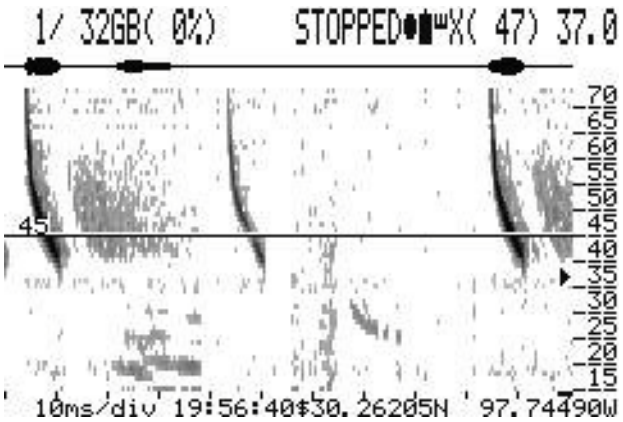
Zooming in the X and Y Axes

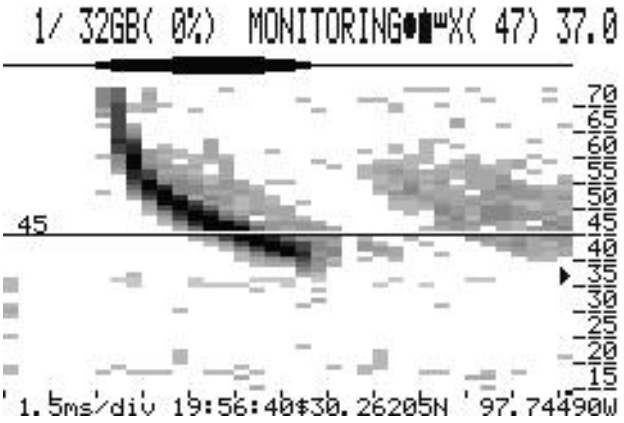
In addition to allowing you to review the spectrogram by scrolling through the buffer, the Arrow buttons and X/Y button allow zooming in on regions of interest. The X/Y button toggles the Arrow buttons between X mode and Y mode. The currently selected mode can be seen in the top line of the LCD display to the right of the Compressed/Expanded icon.

In X mode the Left button scrolls back in time, the Right button scrolls forward in time, the Up button zooms in and the Down button zooms out. Note that everything zooms from the right edge of the screen. The X axis scale is shown in the lower left corner of the display as ms/div (milliseconds per division or tick mark). For the 384kHz sample rate setting, the available divisions are 250ms, 100ms, 50ms, 20ms, 10ms, 4ms, 2ms and 1.5ms. For the 256kHz sample rate setting, the available divisions are 250ms, 100ms, 50ms, 20ms, 10ms, 3ms, 1.5ms and 1ms. If you are scrolled back in time and want to view the present, just double click the X/Y button.

In Y mode, the Right button zooms the Y-axis zoom (frequency) and the Left button restores it. While zoomed in, the Up and Down buttons let you scroll the Y-axis so you can center in on the narrower frequency band of interest. There is only one zoom level on the Y axis. Since the X mode will be used more commonly, if left in Y mode the EM3 will revert back to X mode after a few seconds.

The simulated screenshots below show the same bat echolocations in different modes of operation. The first is shown with the default zoom level, the next with Y zoom and finally with Y zoom and full X zoom.





In all three screenshots, you can see the frequency reference line and in the last two you can also see the triangular HET frequency indicator. All of the above screenshots show the display with the EM3 set to a sample rate of 256kHz. At this sample rate you will see a maximum frequency on the Y scale of 120kHz. If the 384kHz sample rate is selected the Y-axis scale will go to a maximum of 190kHz.

Recording

Active Recording

To begin a recording, press the Record button. This starts a recording in WAC, WAV or WAV/ZC mode depending on the format selected in the settings menu. Once the recording has started, the elapsed time of the recording will be shown on the top line of the diplay as mm:ss RECORD. The recording takes under a second to start, during this time you will see PREPARING on the top line of the display. Note, EM3 is always in Monitoring mode while in Recording mode.

Recording Modes

In WAC mode, triggered WAC files will be made back-to-back based on the Max Duration value in the settings menu.

In WAV or WAV/ZC mode, each trigger will be written as an individual file. At the end of each trigger you will see SAVING at the top of the screen as the file is saved and PREPARING as the next file is readied. When ready, you will see WAIT TRIGGER as the EM3 waits for a triggered event. The process of saving a file and opening a new file in between each recording takes under a second.

You will want to make sure that you have adjusted the zero cross threshold before recording in ZC mode. This process is described in the Monitoring chapter above. The default threshold setting is quite high and is unlikely to record any zero cross data. If no zero crossings are recorded in ZC mode, the file will not be written!

Stopping and Restarting

To end a recording, press the Stop button (pressing and holding the Power button will also stop the recording before powering down). Stop will terminate any active recording and write the file. Stop will also stop the monitoring mode and STOPPED will show on the top line of the display. After stopping a recording, you can press the Mode button to resume monitoring mode. Or press Record to start a new recording and simultaneously initiate Monitoring mode.

Trigger Display

When the EM3 is triggered a circle appears to the right of "RECORD" on the display. The circle also appears when monitoring so you can get a sense of trigger function and adjust settings accordingly.

Time Stamps

WAC recordings are saved in a "Data" folder on the flash card and have names of the form Prefix_YYYYMMDD_hhmmss.wav, where Prefix is the prefix specified in the settings menu, YYYY is the year, MM is the month, DD is the day, hh is the hour, mm is the minute, and ss is the second. In WAC mode, Echo Meter maintains the proper time so that when the triggers are viewed in Song Scope, Wildlife Acoustics' licensed analysis software, the appropriate space is shown between triggers.

When WAC files are converted to WAV or ZC files using WAC2WAV, the files will be time-stamped in the filename with a 1 ms resolution. More information on WAC2WAV can be found in the Viewing the Recordings chapter. WAC2WAV will prepend the tag letter (see next section) to the filename if "split triggers" is selected.

In WAV or WAV/ZC mode, the files are saved to the "Data" folder and the filenames follow the same convention as above but prepend __ in front of the year and add A_/B_/C_/D_ if tagged using the tagging feature.

Tags and Voice Notes

The Echo Meter has the ability to "tag" a recording to aid in organization of your files. The Letter buttons are used to tag the individual triggers. This allows you to efficiently sort tagged recordings during analysis. If in WAC mode, pressing a Letter button will save that information in the WAC file such that when the WAC is converted to WAV or ZC files with "split trigger" selected in WAC2WAV, the tag letter will be prepended to the filename of the resultant WAV or ZC files. If in WAV or WAV/ZC mode, the letter will be prepended to the respective recording file name on the card.

Additionally, holding down any Letter button will extend the trigger window until the button is released. If you speak while holding down the Letter button, your voice will be recorded along with the ultrasonic

signal, so you can effectively record a voice note with the bat calls inside the trigger recording. When listening in the bat analysis software of your choice at real speed you will hear your voice and no bats. If the recording is played slowed down, you will hear the bats, but your voice will be shifted to the infrasonic range and will not be audible.

As there are four options available you can develop any "key" for the tags that make sense to you. For example, "A" might mean that it was possibly a very interesting call which you want to analyze later, "B" might mean that it is definitely not an important recording and can be discarded, etc. Or you can just use one letter as a voice note button and know that any recording that is tagged includes important voice notes.

Scheduled Recording

Scheduled recordings are enabled in the Settings menu. If "enabled" is selected and the unit is shut down, the EM3 will auto-wake at the specified start time, disable the monitoring output, turn off the display backlight, and start a recording in the selected mode (WAC, WAV or WAV/ZC). It will continue to make back-to-back recordings until the specified end time is reached.

While recording, the user can interrupt and stop recording or initiate monitoring, but the Echo Meter will still power off at the specified end time unless the scheduled recording setting is disabled in the Settings menu.

Note that if scheduled recording is not enabled, schedule start and end times are ignored even if set.

Batteries and Charging

The EM3 includes four high capacity rechargeable NiMH AA batteries. These batteries allow up to 12 hours of operating time.

Charging

The integrated charger allows the batteries to be charged by simply attaching the included charger to the power port on the left side of the EM3 and plugging the adapter into the wall. The unit will power down during the charge cycle and cannot be used. The LED on the side of the unit will display amber (red plus green) until charging is compete at which time it will display only green. Recharging dead batteries should take 3-4 hours. It is recommended once a year to replace or condition the batteries in a quality charger to maintain optimal operating time.

It is possible to swap batteries in the field for longer life. If the swapping is done within 30 seconds or so, the clock will not reset. All other settings will be preserved regardless of how long the batteries are absent. Removing the batteries does, however, erase the spectrogram buffer.

Monitoring Battery Life

The top line of the display battery icon shows the battery level in four increments. When the EM3 calculates that the battery life is nearly over, it will alert the user that the batteries are depleted and the unit is shutting down. If recording, the recording will be saved before shutdown. If the EM3 is recording and the batteries are removed, the recording in process will not be saved.

If no button is pressed in Stopped mode for a few minutes, the unit will power down to conserve batteries.

Other Power Options

The EM3 will work with disposable alkaline AA batteries, but the battery icon was designed for the included batteries and will not be accurate. WARNING: Never plug in the included charger if non-rechargeable Alkaline batteries are installed!

The EM3 can also be powered from the power port using a 6V DC supply. When used with a 6V supply, the unit will remain powered up. When used with the included 9V supply, the unit is powered down when charging.

WARNING: Charge only rechargeable nickel metal hydride batteries in the EM3. Charging any other type of rechargeable or non-rechargeable (disposable) batteries may cause them to leak, rupture or explode resulting in risk of fire, property damage, injury or death.

WARNING: Do not use the charger if the LED indicator does not remain continuously red plus green (amber) during the entire charging cycle. If the red light blinks on and off while charging, the EM3 could be damaged and may cause batteries to leak, rupture or explode resulting in risk of fire, property damage, injury or death.

WARNING: Charge only on a fireproof surface and away from flammable material. The EM3 battery charger is designed to terminate the charging process when batteries are fully charged, however, in the event of a defect or damage to the batteries or the EM3, batteries could become extremely hot resulting in risk of fire, property damage, injury or death.

WARNING: Batteries may become hot to the touch while charging.

Flash Cards

One SDHC or SDXC card can be used for recording. The EM3 includes a 4GB card suitable for a night or two of bat recording. For scheduled recordings, SDHC cards are available up to 32GB and SDXC cards are available up to 128GB to allow weeks of recording. A very general rule of thumb for memory consumption with average bat activity using the recommended trigger level settings is 2GB of card use per night in WAC mode and double that in WAV or WAV/ZC modes.

At this time SDXC cards must be reformatted to FAT32 format to work properly. Information on how to do this is available on our Users Forum at www.wildlifeacoustics.com. Support of native SDXC format is planned for a future firmware release.

On the display, card status is either xxx/yyyGB(zz%) to indicate xxx used of yyy total GB and zz% full, or one of the following:

- NO CARD — card not present.
- CARD ERROR — problem mounting card
- FILE ERROR — problem while writing file to card.
- NEW CARD — if you remove a card and replace it with a new card, this is the status until you actually start recording.

The flash card is also used to upgrade the unit's firmware. To upgrade, put the .EM3 firmware image on the flash card in your computer. Turn the EM3 off and insert the card into the EM3. Now turn the EM3 on while holding the Up Arrow button. You will see any firmware files that are on the flash drive. Select the newest firmware and press the X/Y button. The EM3 will upgrade and restart.

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Managing the Recordings

Transferring the Recordings to a Computer

Simply remove the flash card from the EM3 and place in a suitable card reader on your computer. You can open the files directly from the card or drag and drop them onto your computer.

Using Song Scope

Song Scope is Wildlife Acoustics' licensed analysis software for recordings. The WAC recordings can be viewed natively in Wildlife Acoustic's Song Scope software. If the GPS antenna was used, the GPS locations can also be viewed directly in Song Scope by hovering the mouse on an area of the spectrogram. Tags are also directly viewable in the same way.

Using WAC2WAV

You will also want to download and install the latest version of Wildlife Acoustic's free WAC2WAV post-processing software from the "Downloads" section of Wildlife Acoustic's website at www.wildlifeacoustics.com. This software allows you to convert the EM3 WAC recordings to WAV or ZC files for analysis in the software of your choice. The EM3 recordings are compatible with all popular analysis packages. Use of WAC2WAV is covered in the "Help" of that software.

Optional GPS Antenna

An optional GPS antenna is available to log the GPS location of recordings and to sync the clock to the GPS time base with a less than 1 ms error.

Using the GPS Antenna

The GPS antenna plugs into the port on the right side of the EM3 and attaches to the back of the device with the supplied fastening "dots". The antenna can be extended if necessary for better placement (during car transects for example) using a standard CAT-5 network extension (male to female) cable.

When the GPS is plugged in, a "?" will appear to the right of the time on the bottom line of the display. This indicates that a GPS antenna is connected and recognized but not yet synchronized. When the GPS has acquired satellites and is time synchronized, the "?" will be replaced with a "$". If the display shows a "!", an error has occurred communicating with the antenna. Check the connection and try again.

The latitude and longitude will be displayed to the right of the time in decimal degrees format. If the GPS has been used recently in the area, the position fix will take under a minute. If a significant amount of time has elapsed or the GPS has been shipped some distance, the GPS must download new tables. In this case the first position fix can take up to 40 minutes, but subsequent fixes should still occur in under a minute.

The GPS uses the WGS-84 coordinate system and uses WAAS mode for increased accuracy in North America and Hawaii.

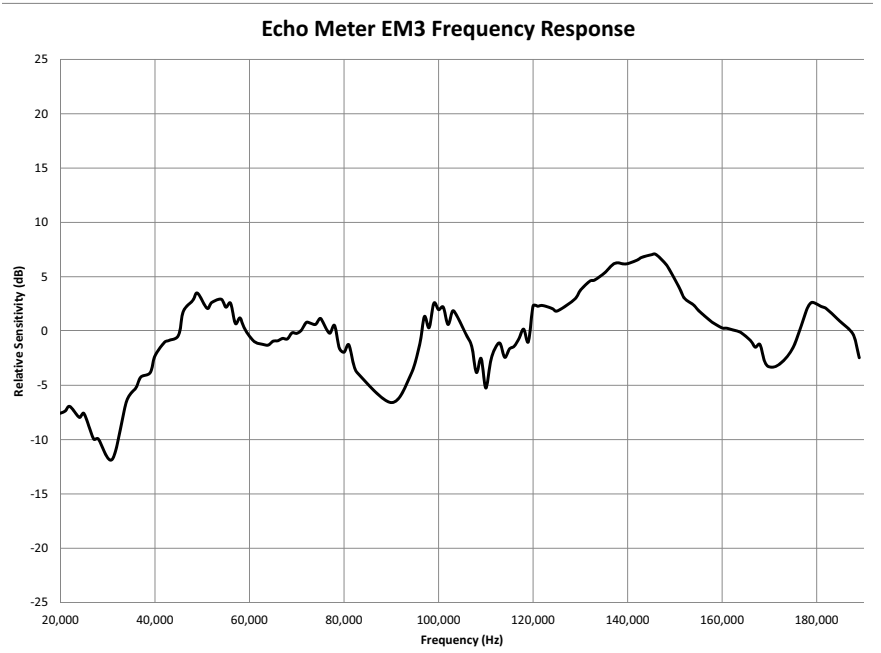
Viewing the GPS Data

GPS data is logged once a second. If the recordings are in WAC mode, location information can be viewed in Song Scope (version 3.4 or later) by

dragging the curser around the spectrogram. If the recordings are in WAC mode and converted to WAV in WAC2WAV, a gps.txt log file with the GPS coordinates from the end of each triggered event will be generated in the converted recordings destination folder. If converted to ZC, the GPS coordinates will be placed within the file such that they can be natively viewed in compatible zero crossing software. If recording in WAV or WAV/ZC mode locations of each WAV will be stored in a gps.txt log file and the location will be embedded in the ZC file. Whether created on the EM3 in WAV or WAV/ZC mode or in WAC2WAV during conversion, the gps.txt file has the appropriate heading to allow easy conversion to Google Map or Earth files using http://www.gpsvisualizer.com/

Specifications

- Dimensions:
    - 5.7 in (14.5 cm) long
    - 3.6 in (9.1 cm) wide
    - 1.25 in (3.2 cm) high
- Weight:12 oz (0.34 kg) with included batteries
- Operating Temperature Range: -4ºF to +185ºF (-20ºC to +85ºC)
- Battery Run Time: Up to 12 hours per charge
- Battery Charge Time: 4 hours
- Audio Sample Rate: 256kHz or 384kHz
- Microphone Directionality:
    - Optimal signal is ±30º vertically and ±60º horizontally
- Effective Microphone Bandwidth: 1kHz to 192kHz
- Microphone Frequency response:



Warranty

Wildlife Acoustics Inc. Limited Warranty

HARDWARE: Wildlife Acoustics, Inc. ("WAI") warrants to the original end user ("Customer") that new WAI branded products will be free from defects in workmanship and materials, under normal use, for one (1) year from the original purchase date. WAI warrants refurbished WAI products, marked and sold as such, for ninety (90) days from the original purchase date.

SOFTWARE: WAI warrants to Customer that any WAI branded software will perform in substantial conformance to their program specifications for a period of ninety (90) days from the date of original purchase. WAI warrants the media containing software against failure during the warranty period. WAI makes no warranty or representation that the operation of the software products will be uninterrupted or error free, or that all defects in the software products will be corrected.

EXCLUSIONS

This warranty excludes (1) physical damage to the surface of the product, including cracks or scratches on the outside casing; (2) damage caused by misuse, neglect, improper installation or testing, unauthorized attempts to open, repair, or modify the product, or any other cause beyond the range of the intended use; (3) damage caused by accident, fire, power changes, other hazards, or acts of God; or (4) use of the product with any non-WAI device or service if such device or service causes the problem.

Any third party products, including software, included with WAI products are not covered by this WAI warranty and WAI makes no representations or warranties on behalf of such third parties. Any warranty on such products is from the supplier or licensor of the product.

EXCLUSIVE REMEDIES

Should a covered defect occur during the warranty period and you notify WAI, your sole and exclusive remedy shall be, at WAI's sole option and expense, to repair or replace the product or software. If WAI cannot reasonably repair nor replace then WAI may, in its sole discretion, refund the purchase price paid for the product. Replacement products or parts may be new or reconditioned or comparable versions of the defective item. WAI warrants any replaced or repaired product, part, or software for a period of ninety (90) days from shipment, or through the end of the original warranty, whichever is longer.

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GOVERNING LAW: This Limited Warranty shall be governed by the laws of the Commonwealth of Massachusetts, U.S.A., and by the laws of the United States, excluding their conflicts of laws principles. The United Nations Convention on Contracts for the International Sale of Goods is hereby excluded in its entirety from application to this Limited Warranty.

Wildlife Acoustics, Inc., 970 Sudbury Road, Concord, MA 01742-4939, United States of America, (888) 733-0200, www.wildlifeacoustics.com

Declaration of Conformity (EN 45014)

- Manufacturer:

  Wildlife Acoustics, Inc.
  970 Sudbury Road
  Concord, MA 01742-4939
  United States of America

- Declares that the following product:

Product Name:	Echo Meter
Product Model Numbers:	EM3
Product Type:	Handheld Bat Detector and Recorder

Conforms to the appropriate country standards and governing regulations listed below. We, as the manufacturer, are fully responsible for the design and production of the above-mentioned equipment.

- FCC Part 15, Class B Federal Communications Commission Rules Part 15
- ICES-003, Class B 2004, Industry Canada, Interference-Causing Equipment Standard, Digital Apparatus
- EN 55011, Class B 2007, Industrial, scientific and medical (ISM) radio-frequency equpment - Electromagnetic distrubance characteristics - Limits and methods of measurement
- AS/NZS CISPR 11, Class B2004, Industrial, scientific and medical (ISM) radio-frequency equipment - electromagnetic distrubance characteristics - limits and methods of measurement

- CISPR Publication 11, 2003/A2, 2006Industrial, scientific and medical (ISM) radio-frequency equpment - Electromagnetic distrubance characteristics - Limits and methods of measurement
- EN 61326-1:2006 Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements
- EN 61000-4-2 Electrostatic Discharge (ESD) 4kV Contact Discharge, 8kV Air Discharge, 4kV Horizontal and Vertical Couppling Planes (HCP and VCP, respectively)
- EN 61000-4-3 Radiated Electromagnetic Fields, 3 V/m, 80 to 1000 MHz; 3V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz

This class B digital apparatus also meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la Classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

This product operates on 6V DC.

This product was tested in a typical configuration. Note that there may be some undesirable recording quality when subjected to electromatnetic interference with the optional GPS attached..

Ian Agranat, President
Wildlife Acoustics, Inc.
November 1, 2011